

$$mv' = m \frac{\Delta x'}{\Delta t'}$$

$$\Delta x' = \Delta x - U \Delta t$$

$$mv' = m \frac{\Delta x}{\Delta t'} - mU \frac{\Delta t}{\Delta t'}$$

$$= m \frac{\Delta x}{\Delta t} - mU \frac{\Delta t}{\Delta t}$$

$$mv' = mv - mU$$

$$p' = p - mU$$